A Revision of the Hawaiian Liriomyza[1]

MITSUHIRO SASAKAWA
KYOTO PREFECTURAL UNIVERSITY, KYOTO, JAPAN

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Liriomyza Mik is the largest genus of Hawaiian agromyzids. Frick (1953) presented a key to the five known species, four of them endemic, basing his distinctions on color and structural characters. However, color, setal length, and eye shape are particularly variable in these species. The present study is an attempt to further the knowledge of the Hawaiian species of *Liriomyza* by a study of material available to me. The descriptions and figures of the male terminalia are presented as the most dependable specific indices. The larval characters and the mine of *Liriomyza minutiseta* Frick are described for the first time.

The terminology used in this paper is the same as that used in my study of the Japanese Agromyzidae (1961).

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Genus **Liriomyza** Mik

KEY TO HAWAIIAN SPECIES OF LIRIOMYZA

1. Scutellum largely yellow; mesonotum with four rows of acrostichals.....2
   Scutellum centrally yellow or entirely brown; mesonotum with five or six rows of acrostichals.....**cocculi** (Frick)
2. Parafrontalia entirely yellow.....3
   Parafrontalia brown laterally.....**brassicae** (Riley)
3. Surstylus only with distal spine; phallic hood bluntly pointed posteriorly..4
   Surstylus with two spines; phallic hood with a pair of teeth at ventral tip.....**hawaiiensis** Frick
4. Mesopleura with small brown spot anteroventrally; sclerites of ventral process large, well developed.....**minutiseta** Frick
   Mesopleura with larger brown area extending for entire ventral length; sclerites of ventral process very narrow, weakly sclerotized.....5
5. Wing length 1.10–1.30 mm.; second costal section 2.6 to 2.8 times as long as the third; on *Indigofera* sp.....**canomarginis** Frick

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Wing length 1.31–1.60 mm.; second costal section 3.0 to 3.5 times as long as the third; on Compositae and Solanaceae..... **pullata** Frick

Liriomyza cocculi (Frick), new combination.,

Phytobia (*Praspedomyza*) *cocculi* Frick, 1953, PROC. HAWAIIAN ENT. SOC. 15:210.

This species is aberrant in that some specimens have the scutellum dark. I have examined five paratypes in the collection of the University of Hawaii and one male specimen form the island of Hawaii, and found two color forms. The dark-colored specimens of this species might be placed in the genus *Phytobia*. However, the yellow scutellum and differences in male terminalia should be sufficient to separate *Liriomyza* from *Phytobia*.

Coloration: Head yellow but ocellar triangle, occiput, dorsal half of postorbit

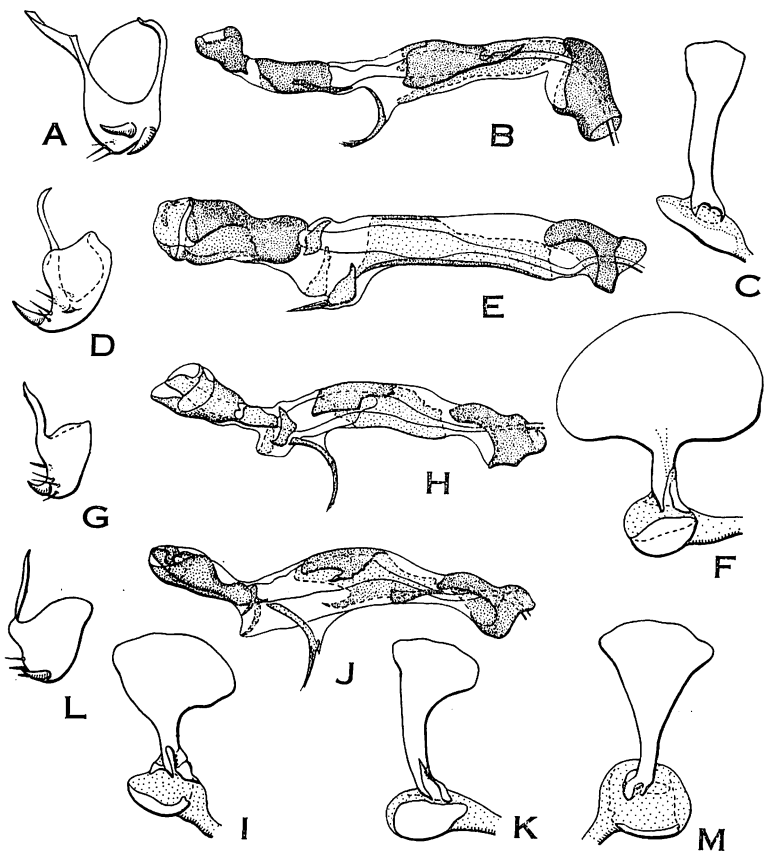

FIGURE 1. Male terminalia: **a-c**, *Liriomyza cocculi;* **d-f**, *L. hawaiiensis;* **g-i**, *L. minutisetad;* **j-k**, *L. canomarginis;* **l-m**, *L. pullata* (*a,d,g,l*, surstylus; *b,e,h,j*, phallus; lateral aspect; *c,f,i,k,m*, ejaculatory apodeme).

dark brown, vertical angle and arista pale brown. Light form (one male and three female paratypes, and one male, Oct. 14, 1962, Sasakawa); mesonotum brown to black, with lateral side yellow, humerus brownish anteriorly; scutellum yellow, darkened laterally; pleura pale testaceous, rarely yellow excepting for sternopleura and hypopleura; dorsal one-eighth to one-fifth of mesopleura, wing base, mesopleural suture and dorsal margin of sternopleura yellow; legs yellow, proximal parts of coxae and dorsal sides of femora more or less tinged with brown; abdomen pale brown, tergites with yellow caudal margins, sixth tergite in male yellow and with brown spot on anteromesal part but in female brown and with yellow margin on caudal one-fourth to one-half; epandrium brown, cercus yellow. Dark form (one male paratype): mesonotum brownish black, slightly gray-dusted, with lateral side brown but posterior margin of humerus and anterior margin of notopleura yellowish; scutellum dark brown; pleura brown, mesopleura and pteropleura slightly yellow-tinged, dorsal margin of sternopleura yellowish; legs pale brown, distal parts of coxae, trochanters and knees yellowish; abdomen brown, very narrowly yellow posteriorly.

Male terminalia: Surstylus long, about one-third as high as epandrium, with two strong spines and two to four setae; cercus three-fifths as high as epandrium; processus longus as long as height of surstylus; phallic hood two-fifths as long as phallapodeme, distally with a pair of ventrally pointed teeth; hypandrium three-fifths length of phallapodeme; praegonite with three setae; postgonite nearly one-half length of hypandrium; phallus about one-half length of phallapodeme, endophallus with distal bulb small and minutely spinulose; ejaculatory apodeme 95–108 μ long, 32–74 μ in greatest width.

Length: Body 0.96–1.59 mm. in male, 1.10–1.65 mm. in female; wing 1.38–1.65 mm. in male, 1.51–1.65 mm. in female.

The phallus of *cocculi* shows similarity to that of the Palaearctic *bryoniae* Kaltenbach but the structure of the surstylus and the shape of the ejaculatory apodeme are distinctive.

Liriomyza hawaiiensis Frick.

Liriomyza hawaiiensis Frick, 1952, PROC. HAWAIIAN ENT. SOC. 14:513.

It was suggested by Spencer that *L. hawaiiensis* might be a synonym or biological race of *brassicae* Riley and that two paratypes of *hawaiiensis* with entirely yellow parafrontalia should be referred to *minutiseta* Frick. However, the present study confirms the distinctness of *hawaiiensis*. In many respects all three species are quite similar, but *hawaiiensis* is clearly separated from *brassicae* and *minutiseta* by the characteristic male terminalia: surstylus one-fifth as high as epandrium, slightly broadened distally, with a strong apical spine and a short spine on anterior median part and four or five setae; phallic hood one-third length of phallapodeme, somewhat swollen at distal end and with a pair of ventrally pointed teeth; phallus about three-fifths length of phallapodeme, endophallus long; ejaculatory apodeme broadly expanded, 112–120 μ long, 120–132 μ in greatest width.

Also, *L. hawaiiensis* is distinguished from *minutiseta* by the brown vertical angle, larger brown triangle on the mesopleura, longer inner post-alar bristle and longer second costal section (3.4–3.7 times as long as the third). Wing length of male measures 1.24–1.31 mm. and female 1.38–1.58 mm.

Specimens examined: Holotype and allotype (in HSPA collection), paratypes, 1 male, 3 females and many males and females, on cabbages and broccoli, Honolulu, Oahu, Feb. 15, 1963, in the collection of University of Hawaii; 1 female, Hilo, Hawaii, Oct 22, 1962, M. Sasakawa, on *Cardamine konaensis* St. John, a new host.

Liriomyza minutiseta Frick.

Liriomyza minutiseta Frick, 1952, PROC. HAWAIIAN ENT. SOC. 14:512.

The essential characteristics of this species are as follows: Head with inner vertical bristle arising from yellow area or at edge of orangish area of vertex and outer from black; mesopleura with a small brown spot anteroventrally, extending dorsally along anterior margin as an indistinct stripe for about one-half its height and ventrally one-half to two-thirds its ventral width (in *hawaiiensis* mesopleura with brown triangle about two-thirds its anterior height and two-thirds to four-fifths its ventral width); wing length of male 1.10–1.44 mm., of female 0.96–1.45 mm., second costal section two to three times as long as third; male terminalia with surstylus relatively large, one-third as high as epandrium, bearing one small spine apically and four setae; phallic hood bluntly pointed distally, without tooth; phallus one-half as long as phallapodeme, endophallus swollen distally, with ventrodistal part projected ventrally; ejaculatory apodeme 80–112 μ long and 45–88 μ in greatest width.

The structure of the male terminalia suggests a relationship with species *pullata* and *canomarginis*, but the shapes of the endophallus and ejaculatory apodeme between them are quite different.

Larva: Full-grown larva pale yellow, 2.4–2.7 mm. in body length. Head with a very narrow patch of minute spines dorsad of sensillae; longitudinal sclerite small; mandible with two teeth; dorsal process of paraclypeal phragma 2.5 to 3 times as long as labial sclerite and rather strongly curved. Anterior spiracles broadly separated from each other at base, 38–52 μ high; knob pale brown, with five or six bulbs; posterior spiracle brown apically, with three bulbs, of which ventral one longer and distinctly projected ventrally. Cuticular process pale brown, triangular; spinal pattern on lateral side as follows: 1T=4·0, 2T=2·0, 3T=4·1–2, 1–3A&7A=5·2–3, 4–6A=4–5·3–4, 8A=5·0. Posterior end with a pair of tubercles on midline between spiracles and anus, and minute papillae beside anus.

Mine: Whitish green in color; ophionome, of upper surface type, 6.5–9.0 mm. in length and less than 2 mm. in greatest width; it begins mostly from center of the leaf, extending toward margin of leaf; grains of frass arranged alternately in short or long threads along lateral sides of the mine but rarely in a very long central line after the second molt. Usually one to four mines per leaf. Full-grown larva escapes from mine through semicircular slit.

Specimens examined: Paratypes 3 males, 1 female, Univ. Hawaii collection; 3 females, Honolulu, Oahu, Sept. 9, 1962, M. Sasakawa, on *Crotalaria retusa* L. (Leguminosae); 12 males, 11 females, Honolulu, Oahu, Sept. 23–28, 1962, Sasakawa, on watermelon; 8 males, 4 females, Kolekole Park, Hawaii, Oct. 14–26, 1962, Sasakawa, on *Solanum nigrum* L. (Solanaceae); 3 males, 4 females, Kalapana Park, Hawaii, Oct. 22–25, 1962, Sasakawa, on *Canavalia microcarpa* (DC.) Piper

(Leguminosae); 2 males, 2 females, Kalapana Park, Hawaii, Oct. 22, 1962, Sasakawa, on *Hydrocotyle verticillata* Thunb. (Umbelliferae); 14 males, 15 females, Honolulu, Oahu, Nov. 16–20, 1962, Sasakawa, on *Passiflora suberosa* L. (Passifloraceae); 5 males, 2 females, Honolulu, Oahu, Apr. 1–2, 1963, Sasakawa, on *Cardiospermum microcarpum* HBK. (Sapindaceae); 5 males, 5 females, Honolulu, Oahu, June 2–4, 1963, Sasakawa, on *Cestrum diurnum* L. (Solanaceae); all are new hosts.

Liriomyza pullata Frick.

Liriomyza pullata Frick, 1952, PROC. HAWAIIAN ENT. SOC. 14:509.

The general structures of this species are very similar to *canomarginis*. Distinguishing features. besides ones given in the key, are the dark-brown vertical angle and anterior six abdominal tergites with narrowly yellow margins posteriorly. In *canomarginis*, the verticle angle is orangish to pale brown, the tergites are yellow laterally and posteriorly and the sixth tergite is almost entirely brownish yellow. The distiphallus of *pullata* is similar to that of *canomarginis*; the hypandrium is longer than all other species (three-fifths as long as the length of phallapodeme); the ejaculatory apodeme is well expanded, measuring 96 μ long and 64 μ broad, while in *canomarginis* 88 μ long and 50 μ broad.

Specimens examined: Paratypes, 1 male, 3 females (University of Hawaii collection); 3 females, MacKenzie State Park, Hawaii, Oct. 21–23, 1962, Sasakawa, on *Emilia sonchifolia* (L.) DC. (Compositae), new host.

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